NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

IRRIGATION WATER CONVEYANCE, GALVANIZED STEEL DITCH AND CANAL LINING

(feet)

CODE 428-C

DEFINITION

A fixed lining of impervious material installed in an existing or newly constructed irrigation field ditch or irrigation canal or lateral.

PURPOSES

This practice may be applied as a part of a resource management system to support one or more of the following:

- Improve control and management of irrigation water.
- Prevent water logging of land due to excess seepage.
- Maintain water quality.
- Prevent erosion.
- Reduce water loss.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to linings made of galvanized steel installed in a pre-formed ditch or canal section.

Linings to which this standard apply are restricted to ditches having characteristics as follows:

Bottom width.....…..Not to exceed 30 inches
Velocity.....…...Not to exceed 15 ft/s

This standard applies to both the ditch and the steel lining.

Ditches and canals to be lined shall serve as integral parts of an irrigation water distribution or conveyance system designed to facilitate conservation use of soil and water resources on a farm or group of farms.

Water supplies and irrigation deliveries for areas served shall be sufficient to make irrigation practical for crops being grown and irrigation water application methods to be used.

Lined ditches and canals shall either be located where they will not be susceptible to damage from side drainage flooding or be protected from such damage.

Steel linings shall not be installed in areas high in salt or other chemical concentrations injurious to galvanized steel unless liners are protected with coatings or anodic protection specifically designed to protect liners from these chemicals.

CRITERIA

General criteria applicable to all purposes

Capacity

A lined ditch or canal shall have enough capacity to meet its requirement as part of the planned irrigation water distribution or conveyance system without danger of overtopping. Design capacity shall be based upon the following, whichever is greater:

1. Capacity shall be adequate to deliver the volume of water required to meet peak consumptive use of crops.
2. Capacity shall be large enough to provide an adequate irrigation stream for all methods or type of systems of irrigation planned.

For design purposes, the carrying capacity of steel-lined ditches and canals shall be considered

to be equal to the capacity as computed by Manning's Formula, using a coefficient of roughness “n” of not less than 0.013.

Velocity

A design velocity in excess of 1.7 times the critical velocity shall be restricted to straight reaches that discharge into a section or structure designed to reduce the velocity to less than critical velocity. Maximum velocity in these straight reaches shall be 15 ft/s.

Freeboard

Required freeboard varies with size of ditch or canal, water velocity, horizontal and vertical alignment, amount of storm or wastewater that may be intercepted, and the change in the water surface elevation that may occur when any control structure is operating. Minimum freeboard for any lined ditch or canal shall be 3 inches.

If velocities are within + 30 percent of critical, freeboard shall be at least 6 inches. Minimum freeboard requirement is based on the assumption that the finished channel bottom elevations will vary no more than 0.1 ft. from design elevations. If a construction deviation between 0.1 ft and 0.2 ft is permitted, minimum freeboard shall be increased an additional 3 inches. Construction deviations greater than 0.2 ft. shall not be permitted.

Additional freeboard shall be provided as required by slope, velocity, depth of flow, alignment, obstructions, curves, and other site conditions.

Water surface elevations

All lined ditches and canals shall be designed so that water surface elevations at field takeout points are high enough to provide the required flow onto the field surface. If ditch checks or other control structures are to provide the necessary head, the backwater effect must be considered in computing freeboard requirements. Required elevation of water surface above field surfaces varies according to type of takeout or device used and amount of water to be delivered. A minimum head of 4 inches shall be provided (a minimum of 6 inches is recommended).

Ditch and canal banks and berms

Ditch and canal banks shall be constructed with earth to at least the top edge of the lining. In cut sections, other than in rock, a berm shall be constructed not less than 2 inches above the top of the lining. Banks and berms shall be wide enough to insure stability of fills and to prevent excessive deposition in cut sections.

For ditches being used to irrigate from, i.e. when using siphon tubes, minimum berm or bank width of 12 inches shall be provided at the top of the lining on both sides of the finished ditch. All other canals and laterals 18 inches at top of lining.

If the bank or berm is to be used as a roadway, the minimum top width shall be adequate for the purpose. Minimum recommended roadway width for straight sections is 12 feet.

Side slopes of Ditch and Canals

Slope requirements vary according to the type of cover material, but side slopes shall not be steeper than 3 horizontal to 1 vertical (3:1).

Outside bank slopes and slopes above the berm elevation in cut sections must be flat enough to insure stability. Minimum recommendation is 2:1 except where vegetation will be maintained by mowing where the minimum shall be 3:1.

Related structures

Plans for ditch or canal lining installations shall provide for adequate inlets, outlets, turnouts, checks, crossings, and other related structures needed for successful conservation irrigation.

Structures shall be constructed or installed in such a way that capacity or freeboard of the ditch is not reduced and effectiveness of the lining is not impaired.

All structures shall meet NRCS standards and specifications for type of structure used.

Bulkheads, formed to fit the lining shall be of sufficient size to extend at least 12 inches into the earthen ditch pad for the entire width of the ditch lining. Bulkheads shall be installed at the beginning and end of the lining section and at

intervening points, as needed, to provide adequate anchorage.

Materials

Galvanized sheet steel used in the linings, battens, related structures, and accessories shall conform to the criteria in ASTM A-525, Coating class 1.25 oz/ft, or in Federal Specification QQ-S-775C, Type 1, Class d.

Minimum thickness of the lining shall be 24 gage for individual sheets 84 inches or less in width and 22 gage for wider sheets. The edges of the sheet linings shall be rolled or pressed into a shape that will provide added strength at the corners and firm anchorage into the ditch at the top of the lining.

Minimum thickness of steel used for bulkheads and related structures shall be 20 gage in accordance with ASTM A-446, Grade C, Steel.

Fasteners used in the assembly of liners and structures shall be zinc or cadmium coated.

Sealer materials shall be able to withstand temperature variations expected at the site.

CONSIDERATIONS

Water Quantity

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, and deep percolation and ground water recharge.
2. Effects on downstream flows or aquifers that would affect other water uses or users.
3. Potential use for irrigation management.
4. Potential changes in growth and transpiration of vegetation located next to the conveyance because of the elimination of leakage from the system.

Water Quality

1. Effects of installing the lining on the erosion of the earth conveyance and the movement of sediment and soluble and sediment-attached substances carried by water.
2. Effects on the movement of dissolved substances to ground water.
3. Effects on wetlands or water-related wildlife habitats.
4. Effects on the visual quality of water resources.

PLANS AND SPECIFICATIONS

Plans and specifications for installing galvanized steel irrigation ditches and canal linings shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purposes

OPERATION AND MAINTENANCE

An Operation and Maintenance plan must be prepared for use by the landowner or operator responsible for operation and maintenance. The plan should provide specific instructions for operating and maintaining the lined ditch to insure it functions properly. Minimum requirements to be addressed in the Operation and Maintenance Plan are;

1. Prompt repair or replacement of damaged components is necessary.
2. Maintain adequate drainage facilities of the foundation.
3. Maintain width of soil berms or banks and vegetative cover on all slopes and water courses
4. Drain all lined ditches when not being used.
5. Remove debris and litter and any blockage that restricts capacity.

List other items specific to Operation and Maintenance of this project on the "Operation and Maintenance Worksheet".

REFERENCES

USDA NRCS, National Engineering Field Handbook for Conservation Practices, Chapter 3, 6, 15.

USDA NRCS, Standard Drawings Handbook Washington.

USDA NRCS, Engineering Design Standards
Far West States.

USDA NRCS, National Engineering Technical
Release 25 (TR-25).